SMART ULTRASOUND REMOTE GUIDANCE EXPERIMENT (SURGE) – CONCEPT OF OPERATIONS EVALUATION FOR USING REMOTE GUIDANCE ULTRASOUND FOR PLANETARY SPACE FLIGHT

Victor Hurst IV[1], Sean Peterson[2], Kathleen Garcia[1], Ashot Sargsyan[1], Douglas Ebert[1], David Ham[1], David Amponsah[3], Scott Dulchavsky[3]
[1]Wyle-Integrated Science and Engineering, Houston, TX, [2]Canadian Space Agency, Saint-Hubert, Quebec, Canada, [3]Henry Ford Hospital System, Detroit, MI

Introduction

Use of remote guidance (RG) techniques aboard the International Space Station (ISS) has enabled astronauts to collect diagnostic-level ultrasound images. Exploration class missions will require this cohort of (typically) non-formally trained sonographers to operate with greater autonomy given the longer communication delays (2 seconds for ISS vs. >6 seconds for missions beyond the Moon) and communication blackouts. To determine the feasibility and training requirements for autonomous ultrasound image collection by non-expert ultrasound operators, ultrasound images were collected from a similar cohort using three different image collection protocols: RG only, RG with a computer-based learning tool (LT), and autonomous image collection with LT. The groups were assessed for both image quality and time to collect the images.

Methods

Subjects were randomized into three groups: RG only, RG with LT, and autonomous with LT. Each subject received 10 minutes of standardized training before the experiment. The subjects were tasked with making the following ultrasound assessments: 1) bone fracture and 2) focused assessment with sonography in trauma (FAST) to assess a patient's abdomen. Human factors-related questionnaire data were collected immediately after the assessments.

Results

The autonomous group did not out-perform the two groups that received RG. The mean time for the autonomous group to collect images was less than the RG groups, however the mean image quality for the autonomous group was less compared to both RG groups.

Discussion

Remote guidance continues to produce higher quality ultrasound images than autonomous ultrasound operation. This is likely due to near-instant feedback on image quality from the remote guider. Expansion in communication time delays, however, diminishes the capability to provide this feedback, thus requiring more autonomous ultrasound operation. The LT has the potential to be an excellent training and coaching component for autonomous ultrasound image collection during exploration missions.